

MATERIAL SAFETY DATA SHEET

SRM Supplier: National Institute of Standards and Technology
Standard Reference Materials Program
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SRM Number: 3165
MSDS Number: 3165
SRM Name: Vanadium Standard Solution
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SECTION I. MATERIAL IDENTIFICATION

Material Name: Vanadium Standard Solution

Description: SRM 3165 is a single element solution prepared gravimetrically to contain a nominal 5 mg/g of vanadium with a nitric acid volume fraction of 10 %.

Other Designations: **Vanadium** (vanadium-51) in **Nitric Acid** (aqua fortis; hydrogen nitrate; azotic acid; engraver's acid);
***Ammonium Metavanadate** (ammonium vanadate; vanadic acid ammonium salt) in **Spectrometric Solution**

Name	Chemical Formulas	CAS Registration Numbers
Nitric Acid	HNO ₃	7697-37-2
Ammonium Metavanadate	NH ₄ VO ₃	7803-55-6
Vanadium	V	7440-62-2

DOT Classification: Nitric Acid Solution, UN2031

Manufacturer/Supplier: Available from a number of suppliers

* The addition of vanadium to nitric acid, along with other intermediate chemical reactions, forms ammonium vanadate which will precipitate upon evaporation or drying of the solution.

SECTION II. HAZARDOUS INGREDIENTS

Hazardous Components	Nominal Concentration (%)	Exposure Limits and Toxicity Data
Nitric Acid	10	ACGIH TLV-TWA: 2 mg/kg or 5 mg/m ³
		OSHA TLV-TWA: 2 mg/kg or 5 mg/m ³
		Human, Oral: LD ₅₀ : 430 mg/kg
Ammonium Metavanadate	1.1	NIOSH TLV-Ceiling: 0.05 mg/m ³
		Rat, Oral: LD ₅₀ : 58 100 µg/kg
		Rat, Inhalation: LD ₅₀ : 7800 µg/m ³ /4 h
Vanadium	0.5	OSHA TLV-TWA: 0.05 mg/m ³ (respirable particulate)
		Rabbit, Subcutaneous: LD ₅₀ : 59 mg/kg

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

Nitric Acid	Ammonium Metavanadate	Vanadium
Appearance and Odor: A white to slightly yellow liquid that darkens to a brownish color upon aging and exposure to light; pungent, irritating odor	Appearance and Odor: A colorless or white to yellow crystalline powder with no odor	Appearance and Odor: A lustrous white or gray powder with no odor
Relative Molecular Mass: 63.02	Relative Molecular Mass: 116.98	Relative Atomic Mass: 50.94
Density: 1.054 (10 % nitric acid)	Specific Gravity: 2.326	Specific Gravity: 5.96
Solubility in Water: Soluble	Solubility in Water: Very slightly soluble	Solubility in Water: Insoluble
Solvent Solubility: Decomposes in alcohol	Solvent Solubility: Soluble in dilute ammonium hydroxide; insoluble in ammonium chloride solutions, alcohol, and ether	Solvent Solubility: Soluble in aqua regia, nitric acid, concentrated sulfuric acid, and hydrofluoric acid

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this vanadium/nitric acid solution do not exist. The actual behavior of the solution may differ from the individual components.

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Method Used: N/A

Autoignition Temperature: N/A

Flammability Limits in Air (Volume %): **UPPER:** N/A
 LOWER: N/A

Unusual Fire and Explosion Hazards: Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Vanadium and ammonium metavanadate are negligible fire hazards when exposed to heat or flames.

Extinguishing Media: Use extinguishing media that is appropriate to the surrounding fire. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen.

Special Fire Procedures: Fire fighters should wear a self-contained breathing apparatus (SCBA) with a full face piece in the pressure demand or positive mode and other protective clothing.

SECTION V. REACTIVITY DATA

Stability: X Stable Unstable

Conditions to Avoid: Avoid contact with incompatible materials.

Incompatibility (Materials to Avoid): Keep nitric acid away from organic materials, plastics, rubber and some forms of coatings. Nitric acid is incompatible with chlorine and metal ferrocyanide. Ammonium vanadate is incompatible with strong acids and bases. Vanadium is incompatible with halogens, oxidizing materials, and metals.

See Section IV: *Unusual Fire and Explosion Hazards*

Hazardous Decomposition or Byproducts: Hazardous decomposition of nitric acid can produce various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO₂), nitrous oxide (N₂O), as well as nitric acid mist or vapor. Thermal decomposition of ammonium vanadate may release ammonia, oxides of nitrogen, and/or vanadium. Thermal oxidation of vanadium may release toxic and/or hazardous gases and oxides of vanadium.

Hazardous Polymerization: Will Occur X Will Not Occur

SECTION VI. HEALTH HAZARD DATA

Route of Entry: X Inhalation X Skin X Ingestion

Health Hazards (Acute and Chronic): Nitric Acid: Nitric acid may be fatal if inhaled, swallowed, or absorbed through skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract (URT), eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Ammonium Metavanadate: Ammonium metavanadate may be fatal if inhaled, swallowed, or absorbed through skin. This material causes severe eye irritation and is irritating to the mucous membranes, and URT. Inhalation may result in metallic taste, digestive disorders, dizziness, headache, chest pain, difficulty breathing, asthma, convulsions, lung congestion, or pneumonia. Repeated or prolonged contact may cause sensitization. A greenish-black discoloration of the tongue may indicate exposure. Vanadium compounds may irritate the skin resulting in a seborrhea-like eczema with intense itching or dermatitis. This material may also cause irritation of the eyes with profuse tearing and burning sensation.

Vanadium: Vanadium may be harmful by inhalation, ingestion, or skin absorption. Exposure may cause irritation of the skin, eyes, mucous membranes, and URT. Inhalation may result in a greenish-black discoloration of the tongue, metallic taste, digestive disorders, difficulty breathing, and/or lung congestion. Vanadium toxicity due to ingestion or inhalation may lead to kidney or liver damage. Vanadium fumes may irritate the skin resulting in a seborrhea-like eczema with intense itching or dermatitis. Fumes may irritate the eyes causing profuse tearing, blurred vision, and a burning sensation.

Medical Conditions Generally Aggravated by Exposure: Eye disorders, respiratory disorders, skin disorders, and allergies

Listed as a Carcinogen/Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	<u> </u>	<u> X </u>
In the International Agency for Research on Cancer (IARC) Monographs	<u> </u>	<u> X </u>
By the Occupational Safety and Health Administration (OSHA)	<u> </u>	<u> X </u>

EMERGENCY AND FIRST AID PROCEDURES :

Skin Contact: Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and treat them accordingly. Obtain medical assistance if necessary.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 min. Obtain medical assistance.

Inhalation: If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration. Obtain medical assistance if necessary.

Ingestion: If ingestion occurs, wash out mouth with water. **DO NOT** induce vomiting. Obtain medical assistance immediately.

NOTE (Nitric Acid): Wash affected skin areas with 5 % solution of sodium bicarbonate (NaHCO_3). If ingested, the risk versus the benefit of the passage of a naso-gastric tube is debatable. Activated charcoal is of no value. **DO NOT** give the exposed person bicarbonate to neutralize the material.

TARGET ORGAN(S) OF ATTACK: **Nitric Acid:** Skin, teeth, eyes, and URT
 Vanadium and Ammonium Metavanadate: URT, liver, and kidneys

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material Is Released or Spilled: Notify safety personnel of spills. Surfaces contaminated with spills should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Waste Disposal: Follow all federal, state, and local laws governing disposal.

Handling and Storage: Provide general and local explosion proof ventilation systems to maintain airborne concentrations below the TLV. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter and vapor respirator when the vapor or mist concentrations are high. Wear gloves and chemical safety glasses where contact with the liquid or high vapor concentrations may occur. An eye wash station and washing facilities should be readily available near handling and use areas. Wash exposed skin areas several times a day with soap and warm water.

NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the laboratory.

SECTION VIII. SOURCE DATA/OTHER COMMENTS

Sources: MDL Information Systems, Inc., MSDS *Vanadium*, June 2, 1999.
MDL Information Systems, Inc., MSDS *Ammonium Metavanadate*, June 2, 1999.
MDL Information Systems, Inc., MSDS *Nitric Acid*, June 2, 1999.
The Merck Index, 11th Ed., 1989.
The Sigma-Aldrich Library of Chemical Safety Data, Ed. II, 1988.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data on the MSDS. The certified value for this material is given on the NIST Certificate of Analysis.